Dendrimer-Lipid Based Nanostructures That Extract, Concentrate and Stabilize Nucleic Acids for Analysis

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Sensor systems based on the isolation and amplification of nucleic acids offer the possibility for improvements in the identification and characterization of biologic systems. For example, the rapid detection and identification of pathogens, tumors or novel organisms are crucial to the success of analysis or specific treatments. While many systems are being developed for the analysis of genetic material, all require the provision of relatively purified genetic material as a starting material. We propose a totally new concept for the analysis of genetic material in either remotetesting in hostile environments or in vivo without disrupting living organisms. These methods combine the binding and concentration of genetic material to stabilize and identify either RNA or DNA. These methods do not require operator input, therefore eliminating the need for an individual to be present to perform the analysis. They also resolve issues of source material availability in situations where it is either too remote (space) or too dangerous (tumors) to obtain. This technique involves nonostructures with two components: one a lipid surfactant the other a dendritic polymer. The lipid can be designed either to fuse with a cell to deliver the polymer material or to disrupt a cell to release its contents. In the latter technique, cells (whether from animals, enveloped viruses, bacteria or even spores) are disrupted by stripping away membrane lipid and protein to release RNA and DNA from the nucleus and cytoplasm. This material is then bound to the polymer and isolated on a solid-phase support for analysis. The polymer-bound genetic material is isolated and concentrated from the solution by adherence onto a solid phase, such as a fiberglass or magnetic rod. The genetic material then could be washed and assayed using field-deployable DNA amplification technology that would allow testing by an automated or portable device. Without stabilization and isolation, cellular enzymes from the pathogen or the environment itself can degrade the released genetic material and make it impossible to analyze. The other technique involves the binding of specific genetic material within cells (mainly mRNA) to complementary oligonucleotide sequences bound to dendritic polymers. The polymers would be aggregated by this interaction, which would cause the generation of a fluorescent signal in a manner similar to a quantum dot. The fluorescent signal is then detected *in vivo* using ultra-short wave (pico or fento-second) laser excitation. These techniques allow for the detection of specific genetic material either in hostile environments at great distances, such as in space exploration, or *in vivo* in a living organism, such as in the diagnosis or characterization of a neoplasm.